Module 19 Lesson Plan

Using Vehicle and Roadway Designs to Manage Risk

Content

Essential Knowledge and Skills 45

- MANAGING RISK WITH VEHICLE AND HIGHWAY DESIGNS
- DEFINING RISK
  - ♦ Control Exposure to Risk
- THE CRASH SURVIVAL FEATURES
  - ♦ Highway Design
  - ♦ Vehicle Design
- COLLISION TYPES
  - ♦ Control the Consequences of a Crash
  - ♦ Minimize the Consequences of a Crash
- ASSIGNMENT
- ASSESSMENT

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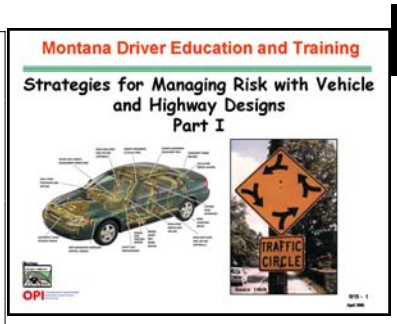
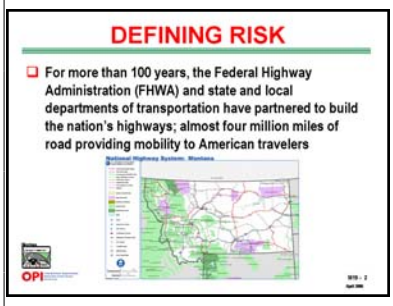
M19—Using Vehicle and Roadway Design to Manage Risk

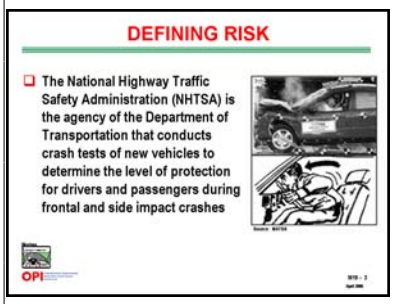
Lesson Objective: The student investigates features built into highway and vehicle design for crash survival, and describes how improved technology helps reduce risk and minimizes the consequences of a crash. The student recognizes the types of collisions that can occur and actions that can be taken to control the consequences.

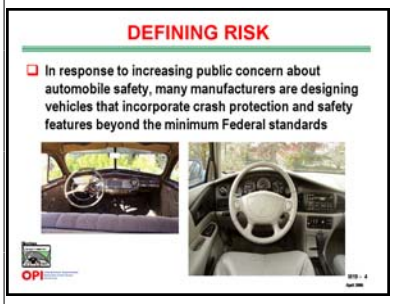
Instructional Topic	Content	Slide
MANAGING RISK WITH VEHICLE AND HIGHWAY DESIGNS	**Introduce, model, practice and discuss** Highway safety has been a never-ending challenge to save lives	T19-1
	• For more than 100 years, the Federal Highway Administration (FHWA) and state and local departments of transportation have partnered to build the nation's highways; almost four million miles of road providing mobility to American travelers	T19-2
	• The National Highway Traffic Safety Administration (NHTSA) is the agency of the Department of Transportation that conducts crash tests of new vehicles to determine the level of protection for drivers and passengers during frontal and side impact crashes ... NHTSA also conducts rollover tests to determine the likelihood of a vehicle rolling over if involved in a single-vehicle crash ... The results of these tests, along with information about safety features for model year 2006 vehicles, are shown in the charts in the brochure *Buying a Safer Car*— copies of the brochure can be ordered by calling the Hotline: 888-327-4236	T19-3
	• In addition, the latest crash test and rollover ratings can always be found at *www.safercar.gov*	
	• In response to increasing public concern about automobile safety, many manufacturers are designing vehicles that incorporate crash protection and safety features beyond the minimum federal standards	T19-4
DEFINING RISK	**Introduce, model, practice and discuss** Driving is a high-risk activity—there is • a crash every five seconds • property damage every seven seconds • injury every 15 seconds • a fatality occurs every 13 minutes	T19-5

Student Learning Activities	Resources







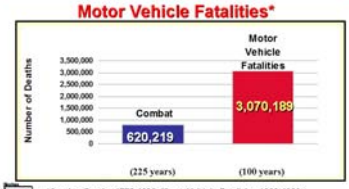


Instructional Topic	Content	Slide
DEFINING RISK (Cont.)	Motor vehicle crashes are the leading cause of death for teen-agers ages 15-20 77 percent have no idea of the level of risk when driving • 83 percent think they have control	T19-6 T19-7
	When drivers feel they have a lot of control in preventing collisions, it follows that they neither see themselves at risk nor see a need to follow safety precautions • 83 percent of the drivers above see themselves at minimal risk in a collision • 91 percent said it would not be their fault	T19-8
	Compare the crash clock to the crime clock • More people die in a crash than by murder • There are more injuries in a crash than injuries caused by aggravated assaults or violent crime • Only property crime or crime exceed crash statistics	
	The fatalities caused by the terrorist attack on September 11, 2001 occur every 25 days on our nation's highways	T19-9
	Compare the number of Americans killed in combat • Since the revolutionary war in 1775 through the 2003 war in Iraq, 650,000 died in combat • Over the last 100 years, 3,070,189 fatalities occurred in motor vehicle crashes	T19-10 T19-11
	There were 42,116 killed in traffic crashes during 2003 • The number of fatalities have remained nearly the same over the last few years • The fatality trend is stable, but how can we call 42,000 dead a success?	T19-12 T19-13
	Driver research shows there are • 90 percent of fatal crashes are the results of driver behavior • 21 percent of those crashes attributed to aggressive driving • 90percent of fatal crashes could have been avoided if driver had reacted one second earlier • 50 percent of all rear-end and intersection related collisions and 30% of oncoming traffic collisions could have been avoided had the driver recognized danger one-half second earlier and reacted correctly	T19-14 T19-15
	<u>Motor vehicle crashes and teens</u> Motor vehicle crashes are the leading cause of death for teen-agers ages 15-20 • Teen-age drivers ages 15-20 account for 7 percent of all drivers but account for 14 percent of all drivers involved in fatal crashes	T19-16

Student Learning Activities

Resources

Americans Killed in Combat vs. Motor Vehicle Fatalities*



*Combat Deaths 1775-1999; Motor Vehicle Fatalities 1900-1999.

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2003 Fatality Statistics

- 42,116 were killed in traffic crashes
- The number of fatalities has remained the same over the past few years
- The fatality trend is stable, but how can we call 42,000 dead a success?

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DEFINING RISK—Driver Research

- 90% of fatal crashes are the results of driver behavior
- 21% of those crashes are attributed to aggressive driving
- 90% of the fatals could have been avoided if the driver had reacted one second earlier

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DEFINING RISK—Driver Research

- 50% of all rear-end and intersection related collisions and 30% of oncoming traffic collisions could have been avoided had the driver recognized danger 1/2 second earlier and reacted correctly

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Motor Vehicle Crashes and Teens

- Motor vehicle crashes are the LEADING cause of death for teen-agers ages 15-20
- Teen-age drivers ages 15-20 account for 7% of all licensed drivers of all ages, but account for 14% of all drivers involved in fatal crashes

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DEFINING RISK

- Motor vehicle crashes are the leading cause of death for teen-agers ages 15-20

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DEFINING RISK

- 77% of all drivers have no idea of the level of risk they take when driving
- 83% of all drivers think they have total control of their vehicle

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DEFINING RISK

- When drivers feel they have a lot of control in preventing collisions, it follows that they neither see themselves at risk nor see a need to follow safety precautions
- 83% of all drivers in a study saw themselves at minimal risk in a collision
- 91% of the drivers said it would not be their fault if they were involved in a crash

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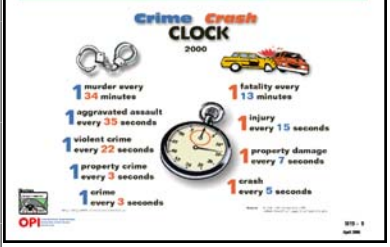
2000 Crash Clock



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Instructional Topic	Content	Slide
DEFINING RISK (Cont.)	A study of *Specific Driving Behaviors Deficiencies of 16 Year Olds that Cause Crashes* (McKnight 2002) 1) Attention 23 percent 2) Adjusting speed 20.8 percent 3) Search ahead 19.1 percent 4) Search to the side 14.2 percent 5) Maintaining space 9.8 percent 6) Tie search to rear/emergencies 9.4 percent	T19-17
	<u>Teen driver facts</u> • Sixty-three percent of teen-age passenger deaths take place when another teen is driving the vehicle. (Insurance Institute for Highway Safety, IIHS, 2001) • Forty-one percent of fatal crashes involving teen-agers occur at night between the hours of 9:00 p.m. and 6:00 a.m. (IIHS, 2001) • In 2000, the estimated economic cost of police-reported crashes involving drivers between 15 and 20 years-old was $32.8 billion (NHTSA, 2001) • Young people age 15-20 represent less than seven percent of the total driving population, but they are involved in 15 percent of all fatal traffic crashes (NHTSA, 2000) • Sixteen-year-olds have almost ten times the crash risk of drivers age 30-59 (Williams, A.F., 1996) • In 2000, of the young drivers who had been drinking and were killed in crashes, 80 percent were not wearing safety belts. (NHTSA, 2001) • Twenty-one percent of young drivers killed in fatal crashes in 2000 had a BAC of 0.10 or higher. (NHTSA, 2001)	T19-18 T19-19 T19-20
	• Male drivers spends an average of 81 minutes a day driving • If a male receives his license at 16 and drives for 60 years, he will drive 29,565 hours in his lifetime • That is equivalent to driving 24 hours a day for 1,232 days or 3.375 years of his life (Source: USA Today USA Snapshots-10/12/98)	T19-21
	Female drivers spend an average of 64 minutes a day driving • If a female receives her license at 16 and drives for 60 years, she will drive 23,360 hours in her lifetime • That is a equivalent to driving 24 hours a day for 973 days (Source: USA Today USA Snapshots-10/12/98)	T19-22
◆ **Control Exposure to Risk**	<u>Safety Belts</u> • The most effective means of reducing fatalities and serious injuries when traffic crashes occur ... Estimated to save 9,500 lives in America each year • Lap/shoulder belts, when used properly, reduce the risk of fatal injury to front seat passenger car occupants by 45 percent and the risk of moderate-to-critical injury by 50 percent • Yet, in the United States. fewer than 60 percent of both adults and children who die in traffic crashes were properly restrained	T19-23

Student Learning Activities	Resources

TEEN DRIVERS: Driving Behaviors

A study of *Specific Driving Behavior Deficiencies of 16-Year-Olds that Cause Crashes* (McKnight 2002)

1) Attention 23%
2) Adjusting speed 20.8%
3) Searching ahead 19.1%
4) Searching to the side 14.2%
5) Maintaining space 9.8%
6) Tie search to rear/emergencies 9.4%

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Teen Driver Facts

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Teen Driver Facts

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Teen Driver Facts

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Teen Driver Facts

- Male drivers spend an average of 81 minutes a day driving
- If a male receives his license at age 16 and drives for 60 years, he will drive 29,565 hours in his lifetime
- That is a equivalent to driving 24 hours a day for 1,232 days or 3.375 years of his life (Source: USA Today USA Snapshots-10/12/98)

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Teen Driver Facts

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- If a female receives her license at 16 and drives for 60 years, she will drive 23,360 hours in her lifetime
- That is equivalent to driving 24 hours a day for 973 days (Source: USA Today USA Snapshots-10/12/98)

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Control Exposure To Risk

Safety Belts: The most effective means of reducing fatalities and serious injuries when traffic crashes occur

- Estimated to save 9,500 lives in America each year
- Lap/shoulder belts, when used properly, reduce the risk of fatal injury to front seat passenger car occupants by 45% and the risk of moderate-to-critical injury by 50%
- In the United States fewer than 60% of both adults and children who die in traffic crashes were properly restrained

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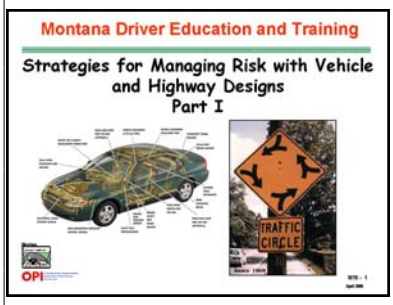
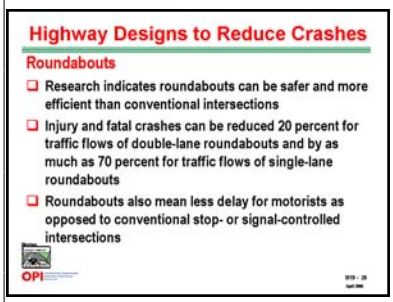
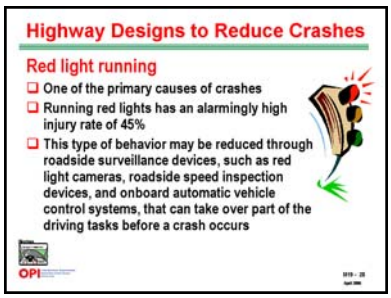
Instructional Topic	Content	Slide
◆ **Control Exposure to Risk (Cont.)**	Drivers who perceive driving to be a high risk activity are more likely to believe that fault could lie with themselves or another driver rather than external condition or bad luck	T19-24
	Use the ten good driving habits to reduce risk (See Module 5) 1. Driver Vehicle Readiness 2. See Clear Path Before Moving 3. Keep the Car in Balance 4. Use Reference Points 5. Do LOS-POT Searching 6. Turn Decisions into Actions 7. Control the Intersection 8. Get Rear Zone Control 9. Control With a Front Vehicle 10. Be Courteous to Others	
THE CRASH SURVIVAL FEATURES	**Introduce, model, practice and discuss** Federal and state agencies have been hard at work designing and building safer roads—here are some examples	M19-25
◆ **Highway Design**	**Roundabouts** Research indicates that well-designed roundabouts with single-lane and double-lane entries, where conditions are appropriate, can be safer and more efficient than conventional intersections	M19-26
	• Injury and fatal crashes can be reduced 20 percent for traffic flows of double-lane roundabouts with approximately 40,000 average daily traffic (ADT), and by as much as 70 percent for traffic flows of single-lane roundabouts up to 20,000 ADT • Roundabouts also mean less delay to motorists as opposed to conventional stop- or signal-controlled intersections	M19-27
	Red light running One of the primary causes of crashes at signalized intersections occurs when motorists enter intersections on a red light and collide with other motorists, pedestrians, or bicyclists who are legally within the intersection	T19-28
	• Red light-running crashes, which occur approximately 200,000 times each year, have an alarmingly high injury rate of 45 percent — significantly higher than the 30 percent injury rate for other crash types • This type of behavior may be reduced through roadside surveillance devices, such as red light cameras, roadside speed inspection devices, and onboard automatic vehicle control systems, that can take over part of the driving tasks before a crash occurs	T19-29

Student Learning Activities | Resources

M19







Instructional Topic	Content	Slide
◆ **Highway Design (Cont.)**	**Intersection controls** The latest controllers for traffic lights use microprocessors that are essentially computers capable of multiple timing patterns and remote communications • Hardware and software have progressed to the point where a laptop computer can control a multitude of signals from virtually any location • In addition, detector technology has progressed beyond the tried-and-true pavement loop detectors • Today, agencies can install magnetic, microwave (or radar), acoustic, or video detection technologies, some of which are installed above the roadway and are not affected by adverse weather or typical utility and roadway work	T19-30 T19-31
	Pedestrian crossing Pedestrian protection systems are creating safer intersections by increasing signal cycle time for pedestrians still in the crosswalk and improving driver compliance with signals • Technologies include in-pavement lighting, illuminated pushbutton pedestrian signals, and automated detectors • Light-emitting diode (LED) pedestrian crossing signal is a new technology that includes a numeric countdown display that activates when the orange hand begins flashing ... Such signals increase safety for pedestrians by providing extra information on signal timing for more informed decisions before crossing	T`9-32 T19-33 T19-34
	Intersection turn lanes Well-defined turn lanes have increased the safety of all roadway users	T19-35
	Retro-reflective traffic signs Many signs in the highway system fail to meet the needs of drivers at night, so the FHWA is establishing minimum requirements for retro-reflectivity—a measure of the amount of light returned to its source—for traffic signs and pavement markings • A key facet of the FHWA's effort to implement minimum retro-reflectivity requirements is a close working relationship with the state and local officials who will be responsible for implementing any new requirements	T19-36
	Pavement drop offs A pavement edge where there is a drop off of more four inches and the angle of the road to the shoulder is 90 degrees is considered unsafe • An estimated 11,000 injuries and 200 deaths per year may be attributed to unsafe pavement drop offs • Once a vehicle has crossed from a paved surface onto an unimproved shoulder, the driver's reaction often is to overcorrect to get back on the road • In the process, the rear wheel may catch on the shoulder edge and spin the vehicle around ... In many instances, drivers attempting to return to the road often veer into the adjacent lane, cross into opposing traffic, or leave the opposite side of the roadway and become a statistic • A temporary safety edge is used until the shoulders can be reconstructed	T19-37 T19-38

Student Learning Activities

Resources

Highway Designs to Reduce Crashes

Intersection turn lanes

- Well-defined turn lanes have increased the safety of all roadway users

Highway Designs to Reduce Crashes

Retro-reflective traffic signs

- The Federal Highway Administration is establishing minimum requirements for retro-reflectivity — a measure of the amount of light returned to its source — for traffic signs and pavement markings

Highway Designs to Reduce Crashes

Pavement drop offs

- A pavement edge is where there is a drop off of more than four inches and the angle of the road to the shoulder is 90 degrees is considered unsafe
- Once a vehicle has crossed from a paved surface onto an unimproved shoulder, the driver's reaction often is to overcorrect to get back on the road
- In the process, the rear wheel may catch on the shoulder edge and spin the vehicle around

Highway Designs to Reduce Crashes

Pavement drop offs

- In many instances, drivers attempting to return to the road often veer into the adjacent lane, cross into opposing traffic, or leave the opposite side of the roadway and become a statistic
- A temporary safety edge is used until the shoulders can be reconstructed

Highway Designs to Reduce Crashes

Intersection controls

- The latest controllers for traffic lights use computers capable of multiple timing patterns and remote communications
- A laptop computer can control a multitude of signals from virtually any location
- Agencies can install magnetic, microwave (or radar), acoustic, or video detection technologies above the roadway and are not affected by adverse weather or typical utility and roadway work

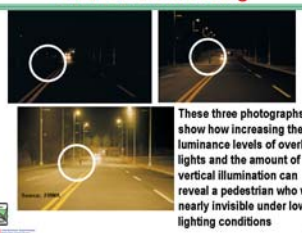
Intersection Controls

Highway Designs to Reduce Crashes

Pedestrian crossing

- Pedestrian protection systems are creating safer intersections by increasing signal cycle time for pedestrians still in the crosswalk
- In many communities a numeric countdown sign is activated when the orange hand begins flashing
- Such signals enable pedestrians to make more informed decisions before crossing

Pedestrian Crossing



These three photographs show how increasing the luminance levels of overhead lights and the amount of vertical illumination can reveal a pedestrian who was nearly invisible under low-lighting conditions

Pedestrian Crossing

In-pavement lighting, illuminated pushbutton pedestrian signals, and automated detectors aid pedestrians and drivers

Instructional Topic	Content	Slide
◆ **Highway Design (Cont.)**	**Median islands** Raised median islands often are associated with traffic calming and speed reduction but they also help separate traffic going in the opposite directions • A raised median island can limit left-turn access while protecting a motorist from the potential hazards posed by landscaping and other fixed objects in the median	T19-39
	Median barriers Median barriers are designed to prevent vehicles from crossing the median and going into opposing lanes • There are different types of median barriers (concrete, steel, and cable) and all are designed to safely stop or redirect a vehicle that enters the median • The most commonly used median barrier in urban areas is the concrete Jersey barrier • Metal beam and cable barriers are commonly used in rural areas • In South Carolina, a new three-strand median cable was tested on all interstate segments with medians less than 60 feet wide ... The installation of these new cable media barriers was 99 percent effective in saving lives	T19-40
	Run off the road crashes Improved signage on rural roads is effective in reducing run-off-the-road-crashes • Chevron signs installed along a rural road in Missouri helped delineate the curve and call attention to a new intersection alignment	T19-41
	<u>Rumble strips</u> Rumble strips are raised or grooved patterns constructed on the roadway's shoulder • Vehicle tires passing over them produce a rumbling sound and cause the vehicle to vibrate ... The noise and vibration produced by the strips are effective alarms for drivers who have drifted from their travel lane onto the shoulder ... Rumble strips are used primarily on expressways, interstate highways, and parkways, although some states are beginning to install them on two-lane rural roads that have high numbers of single-vehicle crashes • Several studies indicate that rumble strips can reduce the overall rate of run off the road crashes by 15 to 70 percent, which would lead also to a reduction in the number of injuries and fatalities	T19-42 T19-43
	<u>Guardrails</u> Without guardrail systems, the carnage on the nation's roadways would be even more gruesome than the 42,000-plus victims that automobile crashes claim each year • Crashes involving vehicles that run off the road account for roughly one-third of those 42,000 annual deaths, and DOT is committed to reducing that figure	T19-44 T19-45

Student Learning Activities

Resources

Highway Designs to Reduce Crashes

Guardrails

- Without guardrail systems, the carnage on the nation's roadways would be even more gruesome than the 42,000-plus victims that automobile crashes claim each year
- Crashes involving vehicles that run off the road account for roughly one-third of those 42,000 annual deaths
- The federal government (FHWA) recently enacted more stringent guidelines governing crash barriers along federally funded highways

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Guardrails

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Highway Designs to Reduce Crashes

Median islands

- Raised median islands often are associated with traffic calming and speed reduction but they also help separate traffic going in the opposite direction
- A raised median island can limit left-turn access while protecting motorists from the potential hazards posed by landscaping and other fixed objects in the median

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Highway Designs to Reduce Crashes

Median barriers

- Median barriers are designed to prevent vehicles from crossing the median and going into opposing lanes
- There are different types of median barriers (concrete, steel, and cable) and all are designed to safely stop or redirect a vehicle that enters the median

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Highway Designs to Reduce Crashes

Run off the road crashes

- Improved signage on rural roads is effective in reducing run-off-the-road-crashes
- Chevron signs delineate curves and call attention to a new intersection alignment

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Highway Designs to Reduce Crashes

Rumble strips

- Rumble strips are raised or grooved patterns constructed on the roadway's shoulder and when tires pass over them produce a rumbling sound and cause the vehicle to vibrate
- The noise and vibration produced by the strips are effective alarms for drivers who have drifted from their travel lane onto the shoulder
- Rumble strips can reduce run off the road crashes by 15 to 70 percent, which would lead also to a reduction in the number of injuries and fatalities

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Rumble Strips

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Instructional Topic	Content	Slide
◆ **Highway Design (Cont.)**	The FHWA recently enacted more stringent guidelines governing crash barriers along federally funded highways	
	Driver Information Systems To enhance driver awareness of traffic conditions, these systems provide traffic and weather information collected by roadside devices • The information is channeled through in-vehicle equipment and roadside information displays	T19-46
	Vision Enhancement Systems In addition to in-vehicle vision enhancement devices, improvements to roadway infrastructure, such as infrared reflective lane-edge marking, can improve a driver's vision	T19-47
	Intelligent Speed Control System This system gathers information on the current speed limit from a roadside speed control system and then provides the information through in-vehicle devices and warns the driver of a speed violation	T19-48 T19-49
	Train-Detection Sensors Systems at highway-rail intersections are designed to improve passive crossings and reduce collisions between automobiles and railcars	T19-50
	• Train-detecting sensors located at highway-rail intersections can detect oncoming trains and warn drivers via variable message signs • Gate running accounts for 22 percent of crashes and 26 percent of fatalities; second train warning signs and law enforcement surveillance detectors can deter drivers from entering an intersection when a train is approaching • Highway congestion is a major factor in gate running, so traffic management systems can play an important role in reducing highway-rail crashes • In-vehicle information devices also can improve driver awareness of highway-rail intersections ... Large trucks, transit vehicles, and school buses equipped with these devices are serving as pioneers in several pilot projects	T19-51
◆ **Vehicle Design**	With safety as a growing concern for car shoppers, more and more manufacturers are using their crash test ratings in ads to pull in buyers • Honda even started putting crash test scores on the window stickers of new cars at dealerships. • According to the Insurance Institute for Highway Safety (IIHS) if you were traveling in a car that was rated "Poor" and got hit by a car rated "Good," you would be three times more likely to be killed in the accident (if there was a fatality) than the driver in the “Good” car	T19-52

Student Learning Activities

Resources

Highway Designs to Reduce Crashes

Driver information systems

- To enhance driver awareness of traffic conditions, this system provides traffic and weather information collected by roadside devices
- The information is channeled through in-vehicle equipment and roadside information displays

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Highway Designs to Reduce Crashes

Vision enhancement systems

- In addition to in-vehicle vision enhancement devices, improvements to roadway infrastructure, such as infrared reflective lane-edge marking, can improve a driver's vision

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Highway Designs to Reduce Crashes

Intelligent speed control system

- This system gathers information on the current speed limit from a roadside speed control system and then provides the information through in-vehicle devices and warns the driver of a speed violation

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Intelligent Speed Control System

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Highway Designs to Reduce Crashes

Train-detecting sensors

- Located at highway-rail intersections can detect oncoming trains and warn drivers via variable message signs
- Gate running accounts for 22 percent of crashes and 26 percent of fatalities; second train warning signs and law enforcement surveillance detectors can deter drivers from entering an intersection when a train is approaching
- In-vehicle information devices also can improve driver awareness of highway-rail intersections
- Large trucks, transit vehicles, and school buses equipped with these devices are serving as pioneers in several pilot projects

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Train-Detecting Sensors

In-vehicle warning systems that are triggered by roadside devices such as this one for a railroad crossing may provide another level of security for the driving public.

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Vehicle Designs for Safer Cars

- With safety a growing concern for car shoppers, more and more manufacturers are using their crash test ratings in ads to pull in buyers
- According to the Insurance Institute for Highway Safety (IIHS) if you were traveling in a car that was rated "Poor" and got hit by a car rated "Good," you would be three times more likely to be killed in the collision (if there was a fatality) than the driver of the "Good" car

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Instructional Topic	Content	Slide
◆ Vehicle Design (Cont.)	**Collision Avoidance Systems** Collision Avoidance systems are like high-tech cat whiskers that are designed to help a driver gauge proximity to other drivers or objects • These systems target avoidance of several kinds of roadway crashes, such as rear-end collisions, road departure collisions, lane change and merge collisions, and intersection collisions • These systems obtain traffic information such as acceleration, relative speed, and distance from other vehicles through sensors in the vehicle, then analyze the likelihood of a collision, and give the driver warning of a high probability of collision	T19-53 T19-54 T19-55
	Driver Status and Performance Monitoring Systems Like an attentive copilot, an onboard driver status and performance monitoring system keeps tabs on the driver • Using sensors to monitor driver performance and psychophysical status, the system identifies dangerous driver conditions (e.g., drowsiness) and distractions and then provides an appropriate warning signal	T19-56
	Vision Enhancement Systems Reduced visibility is a significant factor in 42 percent of all vehicle crashes • Lighting and weather conditions such as glare, dawn, dusk, dark, artificial light, rain, sleet, snow, and fog can cause reduced visibility • In-vehicle vision enhancement services through onboard systems use infrared radiation from pedestrians, animals, and roadside features giving drivers an enhanced view of what's ahead	T19-57 T19-58
	Automated Collision Notification Systems In-vehicle collision notification systems, such as rural mayday systems, send out notification signals automatically when a crash occurs • By reducing the time between the occurrence of a collision and notification of emergency service providers, automated collision notification systems can help emergency responders get to the scene faster and reduce the consequences of a crash	T19-59 T19-60
	Innovative Belt Reminder Systems The purpose of a safety belt reminder is to remind vehicle occupants to wear their safety belts • All vehicles are required to have a four- to eight-second reminder for the driver • This reminder appears as a dashboard warning light (often designed as a person in a safety belt) that also makes a buzzing or bell-like sound • Some manufacturers have voluntarily installed innovative systems that go beyond the federal standard and provide additional warnings when occupants are not using safety belts	T19-61

Student Learning Activities

Resources

Vehicle Designs for Safer Cars

Vehicle Designs for Safer Cars

Collision avoidance systems

- Collision Avoidance systems are like high-tech cat whiskers that are designed to help a driver gauge proximity to other drivers or objects
- These systems target avoidance of several kinds of roadway crashes, such as rear-end collisions, road departure collisions, lane change and merge collisions, and intersection collisions
- These systems obtain traffic information such as acceleration, relative speed, and distance from other vehicles through sensors in the vehicle, then analyze the likelihood of a collision, and give the driver warning of a high probability of collision

Collision Avoidance Systems

The warning is projected on the windshield

Vision Enhancement Systems

Vehicle Designs for Safer Cars

Automated collision notification systems

- In-vehicle collision notification systems, such as rural mayday systems, send out notification signals automatically when a crash occurs
- By reducing the time between the occurrence of a collision and notification of emergency service providers, automated collision notification systems can help emergency responders get to the scene faster and reduce the consequences of a crash

Vehicle Designs for Safer Cars

Driver status and performance monitoring systems

- Like an attentive copilot, an onboard driver status and performance monitoring system keeps tabs on the driver
- Using sensors to monitor driver performance and psychophysical status, the system identifies dangerous driver conditions such as drowsiness and distractions and then provides an appropriate warning signal

Automated Collision Notification Systems

Vehicle Designs for Safer Cars

Innovative belt reminder systems

- All vehicles are required to have a four- to eight-second reminder for the driver that appears as a dashboard warning light (often designed as a person in a safety belt) and also makes a buzzing or bell-like sound
- Some manufacturers have voluntarily installed innovative systems that go beyond the federal standard and provide additional warnings when occupants are not using safety belts
- These systems have visual and/or audio warnings to remind drivers to buckle up; a system to warn passengers is not yet available
- Some of these systems also sense how fast the vehicle is traveling, and increases the frequency of the warning

Vehicle Designs for Safer Cars

Vision enhancement systems

- Reduced visibility is a significant factor in 42 percent of all vehicle crashes
- Lighting and weather conditions such as glare, dawn, dusk, dark, artificial light, rain, sleet, snow, and fog can cause reduced visibility
- In-vehicle vision enhancement services through onboard systems that use infrared radiation from pedestrians, animals, and roadside features to give drivers an enhanced view of what's ahead

Instructional Topic	Content	Slide
◆ **Vehicle Design (Cont.)**	• These systems have visual and/or audio warnings to remind drivers to buckle up; a system to warn passengers is not yet available • Some of these systems also sense how fast the vehicle is traveling, and increases the frequency of the warning • Talk with the dealer or review the owner's manual to find out if the vehicle has one of these innovative systems	T19-62
	Tire Pressure Monitoring System (TPMS) The Tire Pressure Monitoring System (TPMS) uses a dashboard warning light to alert the driver when one or more of a vehicle's tires is significantly underinflated—a leading cause of tire failure	T19-63
	• A tire is considered significantly underinflated when its pressure is 25 percent below the vehicle manufacturer's recommended tire inflation pressure • Beginning with the 2006 model year, manufacturers will begin phasing TPMS into their new vehicles. • By September 1, 2007, all new vehicles will have TPMS	T19-64
	Advanced (Frontal) Air Bag Systems Beginning with 2004 vehicles, advanced air bag systems are required in a portion of each manufacturer's production	T19-65
	• By September 1, 2006, all new vehicles will have advanced (frontal) air bag systems • Advanced air bag systems are a next-generation frontal air bag system designed to further reduce the likelihood of serious injury or death to occupants, whether adults or children, who may be too close to the air bag when it deploys • Most advanced air bag systems use sensors that automatically detect the severity of the crash, the occupant's size, safety belt use, and/or seating position, and deploy the appropriate level of power to the driver's and passenger's frontal air bags • Talk with the dealer or review the owner's manual to learn more about the specific features and sensor technologies in use as part of the advanced air bag system	T19-66
	Side Air Bags (SAB) Side-impact air bag (SAB) technology has advanced rapidly in recent years	T19-67
	• SABs offer additional protection to two main areas of the body — the head and the chest — during side impact crashes • SABs providing head protection show these footnotes in the charts: curtain (c), tubular (t), or combo (b) • Curtain and tubular SABs typically deploy downward from the vehicle's roof rail • Combination or "combo" air bags typically deploy upward from the seat back and provide both head and chest protection	

Student Learning Activities | Resources

M19

Innovative Belt Reminder Systems

Insurance Institute for Highway Safety

Status Report

http://www.highwaysafety.org/

Vehicle Designs for Safer Cars

Tire Pressure Monitoring System (TPMS)

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- A tire is considered significantly underinflated when its pressure is 25 percent below the vehicle manufacturer's recommended tire inflation pressure
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- By September 1, 2007, all new vehicles will have TPMS

Tire Pressure Monitoring System

Vehicle Designs for Safer Cars

Advanced (frontal) air bag systems

- Beginning with 2004 vehicles, advanced air bag systems are required in a portion of each manufacturer's production
- By September 1, 2006, all new vehicles will have advanced (frontal) air bag systems
- Advanced air bag systems are a next-generation frontal air bag system designed to further reduce the likelihood of serious injury or death to occupants, whether adults or children, who may be too close to the air bag when it deploys

Advanced (Frontal) Air Bag Systems

Vehicle Designs for Safer Cars

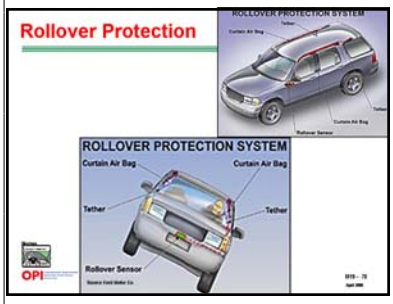
Side Air Bags (SABs)

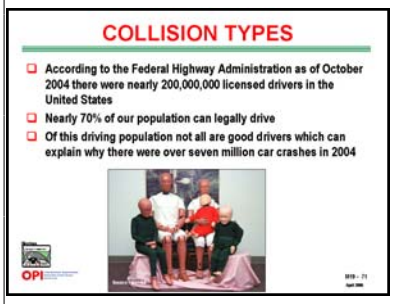
- SABs offer additional protection to two main areas of the body — the head and the chest — during side impact crashes

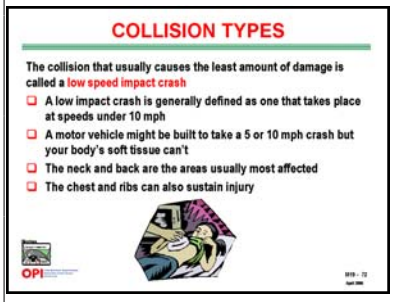
Source: http://www.safeprogram.com

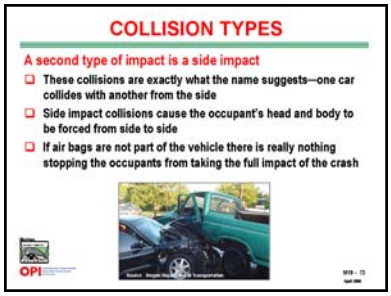
Instructional Topic	Content	Slide
◆ **Vehicle Design (Cont.)**	• SABs providing chest-only protection will have the following footnotes in the chart depending on their mount location: door-mounted (d) or seat-mounted (s) • Read the owner's manual for specific information about the side-impact air bag system in a vehicle **<u>Example:</u>** Upper door panel intrusions/serious injuries • To the head: by the door post • To the chest: by the door and window sill • To the abdomen by the door and arm rest **Rollover Air Bags** With input from a separate rollover sensor, some curtain SABs can be designed to also deploy as *rollover* air bags in the event of a rollover • Rollover air bags stay inflated longer to help keep you inside the vehicle • Ejection is the most common source of injuries and fatalities in rollover crashes • Rollover air bags, along with properly worn safety belts, reduce the risk of injury and ejection	T19-68 T19-69 T19-70
COLLISION TYPES	**Introduce, model, practice and discuss** According to the Federal Highway Administration as of October 2004 there were nearly 200,000,000 licensed drivers in the United States • Nearly 70 percent of our population can legally drive • Of this driving population not all are good drivers which can explain why there were over seven million car accidents in 2004 The collision that usually causes the least amount of damage is called a low speed impact crash • A low impact crash generally is defined as one that takes place at speeds under 10 mph • A motor vehicle might be built to take a 5 or 10 mph crash but your body's soft tissue is not ... The neck and back are the areas usually most affected ... The chest and ribs can also sustain injury • The motor vehicle can take the force of the collision but it needs to push the inertia somewhere and that usually turns out to be the occupants • At first glance low impact accidents might seem to mean low injury or damage but it can be different if you look below the surface • A second type of impact is a side impact ... These collisions are exactly what the name suggests; one car collides with another from the side ... If air bags are not part of the vehicle there is really nothing stopping the occupants from taking the full impact of the crash	T19-71 T19-72 T19-73

Student Learning Activities	Resources









Instructional Topic	Content	Slide
COLLISION TYPES (Cont.)	• These types of accidents are quite serious—in 2000, side impact collisions made up 21 percent of all fatal automobile accidents and 25 percent of all non-fatal automobile accidents ... Side impact collisions cause the occupants head and body to be forced from side to side	T19-74
	• Frontal and rear collisions allow somewhat of a buffer zone ... That buffer zone is the front section of your car with the front bumpers and the engine or the rear bumper and the trunk ... If the oncoming vehicle collides squarely with the second car in the driver's or passenger's door the vehicle and person or persons inside must absorb the full force of the impact	T19-75
	• Frontal collisions cause injuries that are much more severe than those in a low impact accident • The government, insurance agencies and vehicle manufacturers have tested and researched side impact collisions ... The result of these tests was the development of side airbags ... If they deploy properly they can save a life—unfortunately side airbags are not standard on all cars but are becoming more prevalent	T19-76
	• Rollover crashes are also a type of impact accident ... Most rollovers occur when a vehicle runs off a road and turns over on its side or continues to flip over once ... Rollover collisions might involve one vehicle or more and are very serious crashes that result in a high number of fatalities ... Injuries in a rollover accident can be quite serious ... It is believed that the best way to prevent or limit rollover injuries is to use the seat belt and avoid aggressive or erratic driving ... Taking a turn at a high rate of speed, over-correcting a swerve or leaving the even roadway are all conditions that can lead to a rollover	T19-77
	• The injuries that occur from this type of impact depend on the severity of the roll, the amount of times the vehicle rolls, the terrain on which the vehicle overturned and if the occupants can dislodge themselves from the vehicle without assistance ... The worst injuries will occur to a passenger that was not wearing a seat belt and was ejected from the vehicle ... The injuries can be head, soft tissue, neck, chest, arms, legs, ribs and internal bleeding ... One would be lucky to come out of a rollover accident with only cuts, scraps and bruising	T19-78

Student Learning Activities

Resources

Side Impact

- These types of accidents are quite serious—in 2000, side impact collisions made up 21% of all fatal automobile accidents and 25% of all non-fatal automobile accidents

OPI

COLLISION TYPES

Frontal and rear collisions allow somewhat of a buffer zone

- That buffer zone is the front section of your car with the front bumpers and the engine or the rear bumper and the trunk
- If the oncoming vehicle collides squarely with the second car in the driver's or passenger's door the vehicle and person or persons inside must absorb the full force of the impact
- Frontal collisions cause injuries that are much more severe than those in a low impact collision

OPI

COLLISION TYPES

- The government, insurance agencies and vehicle manufacturers have tested and researched side impacts collisions
- The result of these tests was the development of side airbags
- If they deploy properly they can save a life—unfortunately side airbags are not standard on all cars but are becoming more common

OPI

COLLISION TYPES

Rollover crashes are also a type of impact collision

- Most rollovers occur when a vehicle runs off a road and turns over on its side or continues to flip over more than once
- Rollover collisions might involve one vehicle or more and are very serious crashes that result in a high number of fatalities
- Injuries in a rollover accident can be quite serious
- It is believed that the best way to prevent or limit rollover injuries is to use the seat belt and avoid aggressive or erratic driving
- Taking a turn at a high rate of speed, over-correcting a swerve or leaving the even roadway are all conditions that can lead to a rollover

OPI

Rollover Crashes (Cont.)

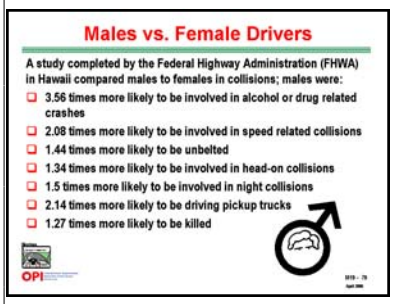
- The worst injuries will occur to a passenger that is not wearing a seat belt and is ejected from the vehicle
- The injuries can be head, soft tissue, neck, chest, arms, legs, ribs and internal bleeding
- One would be lucky to come out of a rollover with only cuts, scrapes and bruising

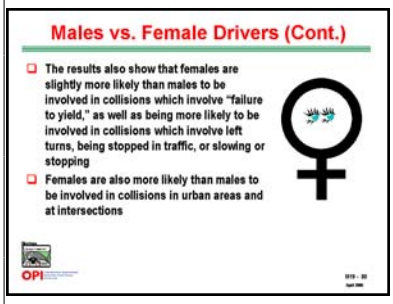
OPI

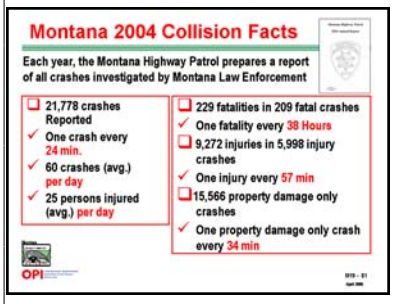
Instructional Topic	Content	Slide
COLLISION TYPES (Cont.)	A study completed "Differences Between Male and Female Involvement in Motor Vehicle Collisions in Hawaii, 1986-1993" by the Federal Highway Administration (FHWA)	
	Compared males to females in collisions, males were: • 3.56 times more likely to be involved in alcohol or drug related crashes; • 2.08 times more likely to be involved in speed related collisions; • 1.44 times more likely to be unbelted; • 1.34 times more likely to be involved in head-on collisions; • 1.5 times more likely to be involved in night collisions; • 2.14 times more likely to be driving pickup trucks, and • 1.27 times more likely to be killed.	T19-79
	The results also show that females are slightly more likely than males to be involved in collisions which involve "failure to yield," as well as being more likely to be involved in collisions which involve left turns, being stopped in traffic, or slowing or stopping • Females are also more likely than males to be involved in collisions in urban areas and at intersections	T19-80
	Each year, the Montana Highway Patrol prepares a report of all crashes investigated by Montana Law Enforcement The 2004 Annual Report shows: • 229 fatalities in 209 fatal crashes ... One fatality every 38 hours • 9,272 injuries in 5,998 injury crashes ... One injury every 57 minutes • 15,566 property damage only crashes ... One property damage only crash every 34 minutes • 21,778 crashes reported ... One crash every 24 minutes • 60 crashes (avg.) per day ... 25 persons injured (avg.) per day	T19-81
	Note: Three charts from the report included in this module can be used to analyze Montana crashes and consider what could cause these crashes and what could possibly reduce the potential of the crash or injuries/fatalities sustained The charts include: • By roadway type • Vehicles by first harmful event • Vehicles by most harmful event	

Student Learning Activities | Resources

M19



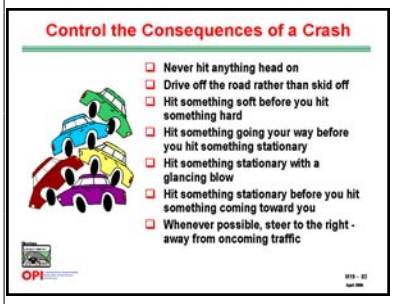


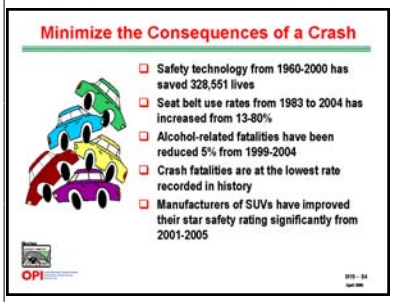


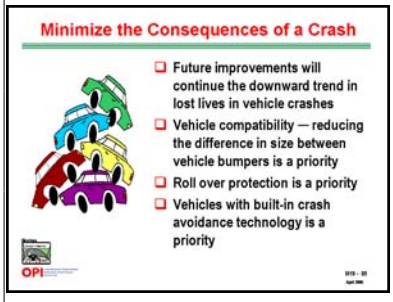
Instructional Topic	Content	Slide
◆ **Control the Consequences of a Crash**	**Never risk more than you can afford to lose** Example: A young driver who breaks a specific traffic law or parental rule resulting in the loss of his license • In this situation, the young driver might be risking too much	T19-82
	Do not risk a lot for a little Example: This behavior might be ignoring a railroad crossing to save a few seconds or even minutes of time • The risk of a very severe crash or an expensive ticket is not worth that small amount of time saved	
	Consider the odds and your situation Distinguish between elements of driving that are beyond a driver's control (actions of other drivers, weather, pedestrians, etc.) from those they do control (speed, use of alcohol, wearing safety belts, obedience to traffic signals, etc.) • In dealing with risk, drivers should try to use those things they can control to help deal with those things they cannot	
	Avoid the consequences of a crash • Never hit anything head on • Always drive off the road rather than skid off • Always hit something soft before you hit something hard • Always hit something going your way before you hit something stationary • Always hit something stationary with a glancing blow • Always hit something stationary before you hit something coming toward you • Whenever possible, steer to the right - away from oncoming traffic	T19-83
◆ **Minimize the Consequences of a Crash**	Highway safety improvements have resulted in fewer crashes, injuries and fatalities Motor vehicle injuries have been reduced from over 3.2 million in 1999 to a projected 2.8 million in 2004 • Safety technology from 1960-2000 has saved 328,551 lives • Seat belt use rates from 1983 to 2004 has increased from 13-80 percent • Alcohol-related fatalities have been reduced five percent from 1999-2004 • Crash fatalities are at the lowest rate recorded in history • Manufacturers of SUVs have improved their star safety rating significantly from 2001-2005	T19-84
	Future improvements will continue the downward trend in lost lives in vehicle crashes • Vehicle compatibility—reducing the difference in size between vehicle bumpers • Improved roll over protection • Vehicles with built-in crash avoidance technology	T19-85

Student Learning Activities	Resources

M19







Instructional Topic	Content	Slide
◆ **Minimize the Consequences of a Crash (Cont.)**	Different vehicles absorb energy in different ways and this explains why the insurance industry rates different cars at different rates • The safer the vehicle is, due to better safety features, the better your insurance company will feel about insuring you • Knowledge of vehicle safety will help buyers choose a vehicle with the best safety features available to keep yourself safe and insurance claims low	T19-86
	<u>Lives saved by safety technologies</u> • 168,524 lives saved by safety belts alone • 160,027 lives saved by all other safety features • Total from 1960-2002 = 328,551	T19-87
ASSIGNMENT		
ASSESSMENT		

Student Learning Activities	Resources